MYCOTAXON

Volume 109, pp. 269–274 *July–September 2009*

Elaphomyces citrinus and *Elaphomyces maculatus* in Sicily (southern Italy)

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Abstract — The first record of *Elaphomyces maculatus* from Sicily is reported. The presence of *E. citrinus* in Sicily, first indicated a century ago by Mattirolo in his monograph on hypogeous fungi of Sardinia and Sicily, is confirmed. Notes on the taxonomy, ecology and distribution of these two infrequent hypogeous fungi are provided.

Key words — macromycetes, Mediterranean area

Introduction

From the beginning of 2000, a research team with dogs trained to find hypogeous fungi has been working in Sicily. The result of this group's activities has been an increase in the number of fungi recorded from the island and a wider knowledge of the ecology and distribution of hypogeous fungi. Searches in several forest ecosystems revealed the presence of two interesting *Elaphomyces* species. As a contribution to knowledge of hypogeous fungi, the ecology and distribution of *E. citrinus* and *E. maculatus* are discussed in this paper.

Materials and methods

Between February 2006 and December 2007, several forest ecosystems at different altitudes were investigated in Sicily, with the help of dogs trained in detection of hypogeous fungi. Specimens were identified while fresh, and microscopic features were observed in an aqueous solution using a Leica microscope DMLB. The scientific binomials of recorded taxa were checked with Index Fungorum (http://www.indexfungorum.org/Names/Names.asp). Macroscopic and microscopic features such as the structure of ascomata, peridium, gleba, asci, and spores, were noted. The cartographic references, habitats, and altitudinal range of each taxon were listed. Distributional

information was referred to the 1:50,000 scale edition of the Official Map of the Italian State (I.G.M.I.), following methodology proposed by Padovan (1994). Specimens have been deposited in the Herbarium Mediterraneum (PAL).

Taxonomic arrangement and data recorded

Elaphomyces Nees (*Elaphomycetaceae*) is a widespread genus including twenty ectomycorrhizal hypogeous fungi (Kirk & al. 2008).

Trappe (1979) proposed a new order *Elaphomycetales* based on *Elaphomyces*, but Kirk & al. (2008) include the genus within the order *Eurotiales*. The species are characterized by hypogeous pulverothecia, mycorrhizal mycelium, and asci developed inside a hollow structure (Weber & al. 1997).

The morphological and microscopic characters of the two species recorded in Sicily are reported below together with the localities of collection and some ecological and distributional notes.

Elaphomyces citrinus Vittad. Fig. 1

Ascomata hypogeous, subglobose, 1–3 cm in diameter, usually covered with an evident, adherent and hard to separate, lemon-yellow mycelium, binding soil particles to form a crust. Cortex thin, ca. 50–80 µm thick, composed of dark brown hyphae, which are heavily carbonised. Peridium rather thick, 1–2 mm with a thinner black carbon-like outer cortex and a dark grey layer below, with a tissue of filamentous hyphae. The mycelium surface is lemon yellow,

Ascomata of *Elaphomyces citrinus* collected in hazel agro-ecosystems.

comprising thin-walled, branched and often anastomosing hyphae, 2.5–4 µm diam. The ripe gleba is composed of a grey-dark brown powder of thin walled hyphae. Asci globose, with 8 spores. Spores spherical, 11–12.5 µm in diameter excluding ornament, dark brown when ripe, lightly aculeate-roughish, ornamented with fine, dense, evenly distributed, rods or spines 0.5–1 µm high. Odour intense, *Tuber*-like.

Localities: Mezz'Agosto, Sant'Angelo di Brolo (province of Messina), 260 m, 599132, 1 Dec 2006, *Corylus avellana* L. cultivation; Castell'Umberto (province of Messina), Ecological Park, 660 m, 599311, 2 Dec 2006, wood of *Quercus ilex* L.; wood of *Q. pubescens* Willd. s.l.,

Elaphomyces maculatus Vittad. Fig. 2

Ascomata hypogeous, subglobose to tuberiform, 4×2.5 cm, bound with a crust of soil, particles and mycelial hyphae, greenish then brown-blackish; surface of peridium smooth or very finely papillate under the lens, glossy, brown-black, often with persistent greenish spots. Peridium consisting of an outer brown-black cortex, and of an inner fleshy layer, 1.5 mm thick, whitish then grey, finally brown-black, and becoming very thin. The ripe gleba consists of a powdery mass of spores and thin-walled, olive-grey hyphae. Asci globose with 8 spores. Spores spherical, coloured, olive to blackish, 34–38 µm. Odour of sour bread or mustard.

Locality: Bosco di Malabotta, Montalbano Elicona (province of Messina), 1250 m, 613442, 22 Feb 2006, mixed wood of *Quercus cerris* L., *Castanea sativa* Mill., *Fagus sylvatica* L.

Ascomata of *Elaphomyces maculatus* collected in oak woods mixed with chestnut and beech.

Discussion

In Europe, *Elaphomyces citrinus* is reported from the British Isles (Cannon & al. 1985, Pegler & al. 1993, Ramsbottom & al. 1951) and from Spain (Vidal 1997). *Elaphomyces citrinus* is also included, as a "non protected" species, in the Inventaire National du Patrimoine Natural (INPN). Pegler & al. (1993) pointed out that *E. citrinus* "has been rarely recorded so that its true distribution and ecology remain uncertain". The first references to the presence of *Elaphomyces citrinus* and *E. maculatus*, in oak woods of northern Italy, were provided by Saccardo (1889). *Elaphomyces citrinus* has been rarely described or illustrated and the previous collections from Italy were limited to the provinces of Milano and Pavia (Vittadini 1831). Mattirolo (1900) published an interesting monograph on hypogeous fungi of Sardinia and Sicily, which included *Elaphomyces* species. The fungi reported were collected for the most part by local people, who helped Mattirolo in his survey. In particular Mr. Fanfani sent Mattirolo a sample of *E. citrinus* collected on April 3rd, 1900 from a chestnut wood in the neighbourhood of the convent of Gibilmanna (Cefalù, province of Palermo). The new find reported in the present work extends the area of distribution of *E. citrinus* to northeastern Sicily and introduces some new aspects to the ecology of this interesting fungus, for example the presence of the species in agro-ecosystems such as cultivated hazel. It also contributes to a better definition of the altitudinal range of *E. citrinus* in Italy, which is currently from 260 to 1250 m, i.e. from the Mediterranean to the Subatlantic vegetational belt (sensu Pignatti 1979).

Elaphomyces maculatus is considered as an infrequent species in Europe and is included in several red-lists. According to IUCN criteria *E. maculatus* was reported as VU in Sweden (http://www.artdata.slu.se/english/redlist.asp) and as V (Exposed) in the Red List of Plants and Fungi of Poland (Wojewoda & Ławrynowicz 2006). *Elaphomyces maculatus* was also included in the Rote Liste Grosspilze of Germany (http://www.pilzbestimmer.de/texte/rote-liste-pilze-de.html) and the Databases at the Department of Cryptogamic Botany-The Swedish Museum of Natural History (www.nrm.se). *Elaphomyces maculatus* was, furthermore, recorded from Sweden by **Kers** (1978) and recently from Hungary (Siller 2005) and Spain (Vidal & al. 1997). In addition to the report by Saccardo (1889), the other most recent record of *E. maculatus* in Italy is from Tuscany (Gori 2005). The authors reported the presence of *E. maculatus* in November, "in a wood" of the province of Lucca (Tuscany), located at 800 m, while Montecchi & Sarasini (2000) reported other localities from the provinces of Parma and Reggio Emilia (Emilia Romagna) and the surroundings of Vicenza (Veneto) in woods of *Fagus sylvatica*, "sometimes mixed with other broad-leaved plants, from summer to the late autumn, at altitudes not higher than 1400 m." The same authors also pointed out some records of *E. maculatus*

on charcoal. The presence of *E. maculatus* in the "subatlantic belt", characterized by beech woods, and the altitudinal range not exceeding 1400 m is confirmed also from Sicily. The fruiting period, usually reported as autumnal in northern Italy, is extended to late winter (February) in Sicily. In our opinion this different ecological datum is due, in some measure, to the different climatic conditions of the island and to the different type of vegetation, which is characterized by a mixed wood of *Quercus cerris*, *Castanea sativa,* and *Fagus sylvatica*.

Finally the size of ascomata and spores of *E. citrinus* and *E. maculatus* collected in Sicily are usually bigger than the measurements reported by Montecchi & Sarasini (2000).

Acknowledgements

The authors wish to thank Dr David Minter (United Kingdom) and Dr Mario Honrubia (Spain) for critically reviewing the manuscript.

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